

REMARKS

Reconsideration of the above-identified patent application, as amended, is respectfully requested. The present amendment is responsive to the Office Action mailed September 25, 2002. A petition for an extension of time in which to respond to the Office Action accompanies this amendment.

By the present amendment, claims 5 to 8 are pending in the application.

Support For Claims

The following is support for new claims 5 to 8 of the present amendment.

Claim 5

New independent claim 5 is based upon original independent claim 1.

In new independent claim 5, the term "comprising" has been replaced with the term --consisting essentially of--.

New independent claim 5 contains the new claim limitation --substantially no copper--.

The specification discloses at page 2, paragraph [0004] that the object of the present invention is to provide "pure titaniums".

The titanium composition of Table 1 at page 11 of the specification under the Column labeled "Other Alloying Elements" in the titanium composition discloses "None".

See also the Abstract of the Disclosure, last two lines, where it is disclosed that aluminum, molybdenum, vanadium and other alloying elements are not added to the titanium of the present invention.

Thus, the limitation "substantially no copper" in the titanium composition of the present invention is fully supported in the specification.

Claim 6

New dependent claim 6 corresponds to original dependent claim 2.

Claim 7

New dependent claim 7 corresponds to original dependent claim 3. With reference to lines 5 & 6 (page 19, lines 2-3) of original dependent claim 3, the phrase "either or both of rolling with rolls" has been changed to --either or both of rolling and leveling with rolls-- in new dependent claim 7.

This is supported in the specification, e.g., at page 3, paragraph [0008].

Claim 8

New dependent claim 8 corresponds to original dependent claim 4.

New matter is not being presented by the present amendment.

Claim Objections

Claim 1 was objected to because it did not end with a period. By the present amendment, claim 1 has been canceled.

Each of new claims 5 to 8 of the present amendment ends with a period.

It is therefore respectfully requested that the objection to the claims be withdrawn.

§112, ¶2

Claims 1-4 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

By the present amendment, claims 1-4 have been canceled and replaced with new claims 5-8 rewritten taking into account the comments of the Office Action in the 35 U.S.C. §112, second paragraph, rejection.

New dependent claim 7 corresponds to original dependent claim 3. New dependent claim 7 is dependent on new dependent claim 6, wherein the limitation directed to "preliminary working" first appears in new dependent claim 6.

In new claims 5 to 8, the term "excellent impact resistance" has been replaced with --impact resistance--. Thus, the objected to word "excellent" has been deleted.

It is respectfully requested that the rejection under 35 U.S.C. §112, second paragraph, as applied to new claims 5 to 8, be withdrawn.

§102/§103

Claim 1 was rejected under 35 U.S.C. §102(b) as being anticipated by Great Britain Patent No. 1,304,572 ("GB `572").

Claims 2-4 was rejected under 35 U.S.C. §103(a) as being unpatentable over Great Britain 1,304,572 in view of U.S. Patent No. 5,666,841 to Seeger et al. ("US `841").

These rejections, as applied to new claims 5 to 8, are respectfully traversed.

Patentability

GB ` 572

Table 1, attached hereto as Attachment A, compares the present invention with GB `572. As is apparent from Table 1, the titanium alloy according to GB `572 contains 0.1 to 2 mass percent copper as an essential element. By comparison, the present invention relates to pure titaniums not containing copper (paragraph [0004]). The titaniums of the present invention are obtained by limiting the concentration of oxygen, nitrogen, carbon and iron generally contained in pure titanium, without adding alloying elements aluminum, vanadium, molybdenum and other alloying elements as described in paragraphs [0002] and [0021] and Abstract. That is to say, the present invention is based on eliminating the addition of alloying elements. The copper contained in the titanium alloy according to GB `572 is an alloying element in the sense used in the present invention

as it is by no means contained in pure titanium. Accordingly, the titaniums according to the present invention are of different compositions from those of the titanium alloys disclosed or suggested in GB `572.

As described above, the present invention relates to titaniums not containing copper that are very different from the titanium alloys of GB `572.

It should not be considered that substances having different compositions but the same hardness have the same impact resistance and other mechanical properties. Addition of copper to titanium is considered to change twin deformation and other deformation mechanisms and, as a consequence, change mechanical properties as well. This is also apparent from embodiment 35 of the present invention and the compared example 47 using Ti-3Al-2.5V that had approximately the same Vickers hardness (Hv*), 232 and 239, but showed greatly different drop-hammer test results, O and ▼, as shown in Table 4 in the specification.

The Office Action maintains that GB `572 does not specifically recite work hardening. The Office Action further maintains that even if product invention is defined by its manufacturing process, inventiveness lies in the product itself. The Office Action maintains that if a finished product is the same as a prior product, the new product has no inventiveness even if it is manufactured by a different process. However, as mentioned earlier, the

titaniums of the present invention and the titanium alloys of GB `572 differ in composition. Therefore, what differs between the two is not only the manufacturing process but the resulting products themselves. Accordingly, the present invention differs from any disclosure or suggestion in GB `572 in both products and manufacturing process.

US `841

The Official Action rejected original claims 2 to 4 for obviousness based on US `841 (U.S. Patent No. 5,666,841) and GB `572. According to the Office Action, US `841 describes that finish rolling is applied after work hardening (by rolling), while GB `572 says it is a common technology to work harden titanium alloys (by rolling) prior to application of finish rolling. The Office Action maintains that processes according to now claims 6 and 7 and the process described in US `841 control the degree of work hardening by final and preliminary working. However, the part (or the extent) to which the work hardenings according to the present invention and US `841 are applied differ as described below.

The technology of US `841 relates to a rolling method for work hardening the notched part of turbine blades or other similar members in which multi-pass rolling is done in the same direction using rolls of small curvature and, then, finish rolling is applied using rolls of large curvature. This method of US `841 work hardens immediately below the notched part, but not the whole of the product.

By contrast, the present invention work hardens the entirety of the product. The hardness attained was measured at a depth of 1/2 and 1/4 of the thickness as described in paragraph [0023] of the specification. It is impossible to work harden the whole of the product by the method of US '841.

Work hardening (by rolling) is a common process for metals and there exist infinite varieties of degrees and methods, as described in lines 33 to 67, Col. 1 of US '841.

Even so, it is submitted that defining the degree and method of work hardening, according to the present invention, to enhance the desired property of metals of specific kind or shape is a unique, sufficiently new technology having an inventive advance. Thus, the present invention which defines the range of composition ($S = [O] + [N] + [C]$ and Fe) and the hardness HV* after work hardening corresponding to the range of composition in order to enhance impact resistance properties is patentable.

The Office Action maintains the GB'572 does now refer to the rolling in a perpendicular direction described in claim 3. Still, the Office Action points out that US'841 described the effectiveness of multi-pass rolling in application of compressive stress and, therefore, application of multi-pass rolling to impart compressive stress to the titanium alloys according to GB'572 is a common technology. However, US'841 relates to a method for applying multi-pass rolling in the same direction to the

inside of a notch in, for example, turbine blades using rolls of small curvature, as explained in the description of Fig. 2 in US'841. US'841 does not refer to the rolling in a perpendicular direction.

Regarding the annealing described in original claim 4, the Office Action maintains that GB'572 described that the alloys according to it are used "as annealed". However, copper is added to the titanium alloys according to GB'572, whereas the present invention relates to titaniums not containing copper. That is, GB'572 and the present invention differ in composition. In addition, the titaniums according to the present invention are finally work hardened by application of forming or other means. Original claim 4 of the present invention relates to a manufacturing process that specifies application of annealing before final forming and/or during preceding rolling. As the titaniums according to the present invention are not used "as annealed" unlike the case of GB'572, the present invention is by no means disclosed or suggested.

It is therefore submitted that new independent claim 5, and claims 6-8 dependent thereon, are patentable over Great Britain Patent No. 1,304,572 and/or U.S. Patent No. 5,666,841 standing alone or in combination.

Drawings

Form PTO-948, Notice of Draftspersons Patent Drawing Review, was not attached to the Office Action. Applicants respectfully request to be advised of the status

of the drawings in the next communication from the Patent and Trademark Office.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed to issue.

Respectfully submitted,

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Attachment A - Table 1 - Comparison of GB `572 and the Present Invention.

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ATTACHMENT A



Table 1. Comparison between GB' 572 (Great Britain Patent No. 1,304,572) and Our Application

| Description | GB' 572 | Our Application |
|-------------|---|--|
| Composition | <u>Specified in claim 1</u> Titanium alloys comprising: Cu 0.1~2 mass% C \leq 0.1 N ₂ \leq 0.05 H ₂ \leq 0.0125 O ₂ \leq 0.1 Fe \leq 0.05 Others \leq 0.05 Therefore, S = [O]+[N]+[C] \leq 0.25 mass% | Specified in claim 1 (and common through claims 1 to 4) S = [O]+[N]+[C] = 0.04~0.27 mass% Fe \leq 0.1 mass% <i>Substantially No Cu</i> |
| Hardness | <u>Described in specification</u> \leq 170 (136 and 137 in embodiments) HV* calculated from the above composition = 158~217 | <u>Specified in claim 1 (and common through claims 1 to 4)</u> HV* is the Vickers hardness hardened by working and specified according to the value of S. |
| Condition | <u>(Specified in claim 1)</u> Annealed It is described that the embodiments were "furnace cooled at 800°C for 1 hour". | <u>Specified in claim 1 (and common through claims 1 to 4)</u> Hardened by working Annealing applied midway, as described in claim 4, is applied at 350~700°C for 10 minutes to 2 hours, preferably at 400~600°C for 1 hour to 2 hours (as described in paragraph [0022]). |

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